Health Start

Fiscal Year 2007 Evaluation Report

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Executive Summary

This report fulfills the Auditor General's requirement for conducting an evaluation with the purpose of assessing differences in birth outcomes for Health Start Program participants and the general population. Out of several hypotheses tested by this study, the major hypothesis was to examine birth weight differences between Health Start Program and non-Health Start Program women. The data pertains to state fiscal year of 2007, starting July 1, 2006 and ending on June 30, 2007. Health Start data was matched with birth certificate data using birth certificate numbers on similar risk factors in both samples. After matching both sets of data, a random sample of 5,722 cases was utilized to conduct logistic regression analyses predicting birth weight.

The findings of the study indicate that the Health Start Program had a positive impact on birth outcomes, even after controlling for the effects of gestational age, adequacy of prenatal care (scores on the Kotelchuck Index), mother's race/ethnicity, residency (whether she lives in a rural or urban area), age, education, weight gain during pregnancy, maternal history of preterm birth, alcohol and cigarette use during pregnancy. Key findings of the study are summarized below:

- The likelihood of having a normal birth weight baby (i.e., ≥ 2,500 grams) for Health Start women was two times greater than that of non-Health Start women.
- The proportion of full-term babies (i.e., gestational age ≥ 37 weeks) was higher for Health Start mothers (92.39%) than non-Health Start mothers (80.60%) and this difference was statistically significant.

While the major hypothesis of birth weight was confirmed, the Health Start Program did not reach anticipated levels in regards to prenatal care. On average, Health Start participants had a lower number of prenatal visits when compared to non-Health Start participants and scored lower on the Kotelchuck index of prenatal care.

Background and Legislation

The origin of the Health Start Program (HSP) can be traced back to 1982, when Arizona was experiencing an increase in the rate of women receiving inadequate or no prenatal care. In 1984, the Rural Health Office of the University of Arizona developed a lay health worker program to address gaps in the health care infrastructure in Arizona. One of the earliest programs, “Un Comienzo Sano/A Healthy Beginning” was established to deliver prenatal and perinatal care particularly among rural and minority populations. In 1990, the state was ranked 45th in the nation for the number of women receiving adequate prenatal care. The Health Start Program was established in 1992 in the State of Arizona with a focus to identify and serve pregnant women and their families in high risk communities by providing maternal and child health education materials, classes, and enable their access to other health care providers and governmental agencies.

Arizona Revised Statute (A.R.S.) 36-697 describes the administration protocol of the Health Start Program and outlines some of its key requirements:

> …The program shall serve pregnant women, children and their families. The program shall be statewide, based in identified neighborhoods and delivered by lay health workers through prescheduled home visits or prescheduled group classes that begin before the child's birth or during the postnatal period and that may continue until the child is two years of age….

According to the statute, the key program goals include: reducing the incidence of infants with low birth weight (i.e. less than 1500 grams) and who require more than 72 hours of neonatal intensive care; reducing the incidence of children affected by childhood diseases; (3) increasing the number of children receiving age appropriate immunizations by two years of age; (4) increasing awareness by educating families; and (5) increasing prenatal care services to pregnant women. The program goals are achieved through the services of community paraprofessionals and/or lay health workers who mirror a similar socio-cultural, ethnic and racial background of the neighborhoods they serve. The HSP is administered by the Bureau of Women and Children's Health in the Arizona Department of Health Services.

Lessons Learned

In December 2003, the Auditor General's Office conducted a performance evaluation of the Health Start Program and recommended several areas for improvement, especially related to data collection and reporting. In reply to the Auditor General's findings, the Office of Women's and Children's Health (now Bureau of Women and Children's Health) developed priorities for data collection to ensure that the program could fulfill its mandated duty to report on the statutory goals, and fulfill the program's duty to its clients. This evaluation report fulfills the requirement of reporting. The first evaluation report was done in 2006 titled 'Health Start 2006 Annual Report,' and published in 2007. This report reviewed all Health Start client data and developed several recommendations for future program efforts. One the recommendation was to target African American women since they were identified as being overrepresented in the 'high risk' population (i.e., high incidence of low birth weight babies). Other recommendations included revising risk assessment criteria, data collection forms, improving data quality for capturing changes over time, and focusing on preconception and interconception care.

The 2006 annual report revealed some positive findings. For instance, Health Start clients were more likely to enter first or second trimester prenatal care than a comparison group of non-Health Start women with similar risk factors (93 percent vs. 87 percent) and scores on the

Kotelchuck Index[1] were higher for Health Start women than a comparison group (67 percent versus 56 percent). However, the study did not find significant gains in birth weight for Health Start women: “During 2005, one percent of all babies born in Arizona weighed less than 1,500 grams, which is considered very low birth weight. The proportion of very low birth weight infants born to Health Start participants and controls was also one percent” (Health Start Annual Report, 2006).

The current evaluation report builds on some of the strengths of the previous report and applies a more rigorous method to examine the outcomes of the Health Start Program. One of the primary goals of the Health Start Program is to reduce the incidence of low birth weight. A closely related goal is to increase the gestational period of the pregnancy (to 37 weeks or later). Therefore, a major focus of this study is to compare the birth weight outcomes and gestational ages of babies born to Health Start mothers and non-Health Start mothers (non-HSP). Another focus of this evaluation study is to measure the adequacy of prenatal care received by Health Start women (compared to non-HSP women).

Literature Review

The Center for Disease Control and Prevention defines low birth weight as less than 5 pounds, 8 ounces (2,500 grams) and preterm birth is defined as birth prior to 37-weeks of gestation. Low birth weight is one of the leading factors in predicting infant mortality and morbidity (e.g., McCormick, 1985; Wilcox and Skjaerven, 1992). In fact, the risk of infant mortality is 20 times higher for low birth weight babies than normal weight infants (Boardman, Powers, Padilla, & Hummer, 2002). Low birth weight is therefore, an important indicator of the

[1] The Kotelchuck Index, also called the Adequacy of Prenatal Care Utilization (APNCU) Index, assesses when prenatal care began (initiation) and the number of prenatal visits from when prenatal care began until delivery (received services).

current health status of a new born as it constitutes a good predictor of health problems later in the child's life.

Low birth weight (LBW) outcomes are governed by two major processes: duration of gestation and intrauterine growth rate. LBW is caused by either short gestation and/or retarded intrauterine growth; however, the causes of LBW are numerous. Kramer (1987) reviewed 43 factors in his meta-analytic study of LBW comprising of seven core determinants:

i) genetic and constituent factors (e.g., newborn's sex, race and ethnicity, maternal height and pre-pregnancy weight)

ii) demographic and psychosocial factors (e.g., maternal age, socioeconomic status, marital status, mother's psychological well-being)

iii) obstetric factors (e.g., pregnancy interval, sexual activity, prior spontaneous or induced abortion, prior stillbirth and/or neonatal death, prior infertility)

iv) nutritional factors (e.g., gestational weight gain, caloric intake, work and physical activity, protein intake, iron and anemia, folic acid and vitamin B_{12})

v) maternal morbidity during pregnancy (general morbidity and episodic illnesses, malaria, urinary tract infection (UTI) and genital tract infection)

vi) toxic exposures (e.g., cigarette smoking, alcohol consumption, caffeine and coffee consumption, use of marijuana and other narcotic drugs)

vii) prenatal care (time of first prenatal care visit, number of prenatal visits, and quality of prenatal visits).

In 1993, Kallan identified several risk factors for LBW to include socio-demographic factors (age, education, marital status), health-related factors (parity, prior fetal loss and LBW, hypertension, diabetes, and infectious disease), attitudinal issues (wantedness of pregnancy), and behavioral factors (smoking, prenatal care, etc.). These risk factors were ordered into the conceptual framework, which is shown in Figure 1.

	SOCIODEM-OGRAPHIC	HEALTH	ATTITUDES AND BEHAVIORS		
	1	2	3	4	
Race	Age Marital Status Education	Parity Prior Outcmes Hypertension (ever) Diabetes (ever) PID (ever)	Wantedness	Smoking Prenatal Care	Pregnancy Outcomes

Figure 1. Determinants of Pregnancy Outcomes (Kallan 1993, p. 490)

In a more recent review of low birth weight, Shah and Ohlsson (2002) identified several factors that not only overlap with those identified by Kramer (1987) and Kallan (1993), but also indicate whether or not there is any ‘proven’ association. Factors that are ‘proven’ to be associated with LBW include:

- short or long birth intervals (<18 months or >60 months)
- previous history of preterm or low birth weight births
- race/ethnicity (African American)
- extremes of maternal age
- maternal malnutrition
- bacterial vaginosis
- urinary tract infection
- HIV infection
- chronic stress
- low socioeconomic status
- alcohol, tobacco and/or cocaine use; passive smoking/environmental tobacco smoke exposure
- violence/abuse
- prenatal care
- placental factors
- multiple births

Potential or ‘unproven’ determinants of low birthweight include:

- maternal parity (first born)
- marital status (single)
- inadequate weight gain during pregnancy
- low pre-pregnancy weight
- short maternal height
- maternal medical/pregnancy associated conditions
- maternal trichomoniasis infection
- periodontal infection
- heavy caffeine use
- marijuana use
- licorice ingestion
- environmental pollution
- noise
- occupational hazards
- physically demanding work and prolonged standing at work
- uterine factors
- pharmacological factors
- paternal factors
- genetic factors

Since measuring all factors related to LBW and infant mortality and morbidity is not feasible within a single evaluation study (due to limitations of measurement and availability of data), the current evaluation study focuses its efforts on examining birth weight differences between Health Start Program (HSP) and non-Health Start Program participants (non-HSP).

Hypotheses

The basic purpose of any evaluation study is to assess whether a given program has an impact on identified outcomes. As previously discussed, the Health Start Program was developed for several purposes: to increase the number of children receiving appropriate immunizations by the age of two; to increase access to prenatal care services; and ultimately, to ensure positive birth outcomes or reducing the incidence of low birth weight babies. The first hypothesis of this evaluation study therefore pertains to birth outcomes:

> H_1: *The average weight of a Health Start baby should be higher than that of non-Health Start participants.*

Alternatively, a lesser proportion of babies born to HSP clients should have LBW when compared to the general population. Moreover, this finding should persist even after statistically controlling for several risk factors such as race and ethnicity, maternal age, education, geographic residence, tobacco and/or alcohol use, weight gain during pregnancy, and history of preterm births.

As noted earlier, two important processes influence low birth weight: intrauterine growth and short gestation. Intrauterine growth can be assessed accurately through ultrasound biometry[2]; however, this data is typically difficult to obtain from vital and/or medical records. On the hand, data on gestational age is readily available from birth certificates. Accounting for other variables,

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[2] See: Pelegy, D., Kennedy, C.M., & Hunter, S.K. (1998). Intrauterine growth restriction: identification and management. *American Family Physician, 58*(2), 453-460.

one should then expect the gestational age for HSP participants to be higher than a comparison group from the general population (non-HSP participants). Stated as a hypothesis:

> *H_2: The proportion of preterm births (less than 37 weeks of gestation) will be lower for HSP participants when compared to non-Health Start participants.*

Prenatal care is also associated with maternal and child health outcomes (Institute of Medicine, 1985; Goldfarb, Hillman, Eisenberg, Kelley, Cohen, & Dellheim, 1991; Schenker, Bell, Edwards, Keesey, Gregory, & Kahn, 1997). Women who receive prenatal care in the first trimester have better pregnancy outcomes than women who receive little or no prenatal care (Alexy, Nichols, Heverly, & Larson, 1997; Kotelchuck, 1994; National Center for Health Statistics, 1988a). This outcome is examined through two measures: the total number of prenatal care visits as well as computation of Kotelchuck Index scores (APNCU) for HSP women and non-HSP women; the associate hypotheses are as follows:

> *H_3: The number of prenatal care visits will be higher for HSP participants when compared to non-Health Start participants.*

> *H_4: The proportion of HSP mothers who meet adequacy of prenatal care on Kotelchuck Index scores should be higher for HSP participants when compared to non-Health Start participants.*

The underlying rationale for these hypotheses is that while quality of prenatal care cannot be determined due to lack of data one could estimate whether or not a mother was able to get early and/or adequate prenatal care. Women who receive prenatal care in the first trimester have better pregnancy outcomes than women who receive little or no prenatal care (Alexy, Nichols, Heverly, & Larson, 1997; Kotelchuck, 1994; National Center for Health Statistics, 1988a).

Methodology and Research Design

Data and Sample

Data for Health Start clients and the non-Health Start population relates to state fiscal year (SFY) 2007, which begins on July 1st, 2006 and ends on June 30th, 2007. For the purpose of the analyses presented below, only singleton births were utilized. This technique, which is used by many studies on birth outcomes (see bibliography for references), has the added benefit of ruling out additional risk factors for poor birth outcomes associated with twins, triplets, etc.

As an initial step, the data for the Health Start clients was drawn for the SFY07 from the Health Start database with unique identifiers such as participants ID, date of birth of the mother and the child, gender of the child, mother's first name, maiden name, and last name, child's first name, maiden name, and last name. Once the data was retrieved any duplicate cases and/or invalid data elements were removed to obtain 595 records of HSP clients, whom were enrolled in the program during the prenatal phase.

Second, the Health Start Program records were matched with birth certificate data for Arizona residents during the same time-period. The matching process was done in several stages, which included matching through 'LinkPlus,' a CDC software program[3] that matches data based on unique identifiers, and by manual matching all 595 records for verification purposes. While the latter method is much more cumbersome, it was found to be most reliable in terms of accuracy and it produced a much lower attrition rate. When using the CDC software, over half of the sample was lost due to attrition whereas the manual match produced a 93% matching rate. A total of 554 cases for HSP were determined to be appropriate and accurate for analyses.

[3] Link Plus v2.0 is a probabilistic record linkage program developed at the U.S. Centers for Disease Control and Prevention (CDC), Cancer Division. Link Plus was written as a linkage tool for cancer registries, in support of CDC's National Program of Cancer Registries.

In selecting the comparison group (non-HSP women), one method would be to simply take a random sample of pregnant women from the general population and compare their birth outcomes to the HSP population. However, this method would fail to take into account the unique characteristics of Health Start Program women, and as a result, the comparison group would likely differ from the HSP group in terms of race/ethnicity, geographical residence, and medical risk factors. To make the groups more comparable, an extensive matching process was undertaken. Before describing this process, we turn attention to the unique characteristics of the Health Start Program participants.

The majority of the population in the HSP describe their ethnicity as Hispanic (73.9%) followed by non-Hispanic Whites (13.4%), Native Americans (11.4%), African Americans (0.9%) and Asian Americans (0.4%). Approximately 55 percent of Health Start clients reside in rural areas of Arizona.[4] Figure 2 gives an overview of the geographic distribution of the HSP population by Arizona counties.

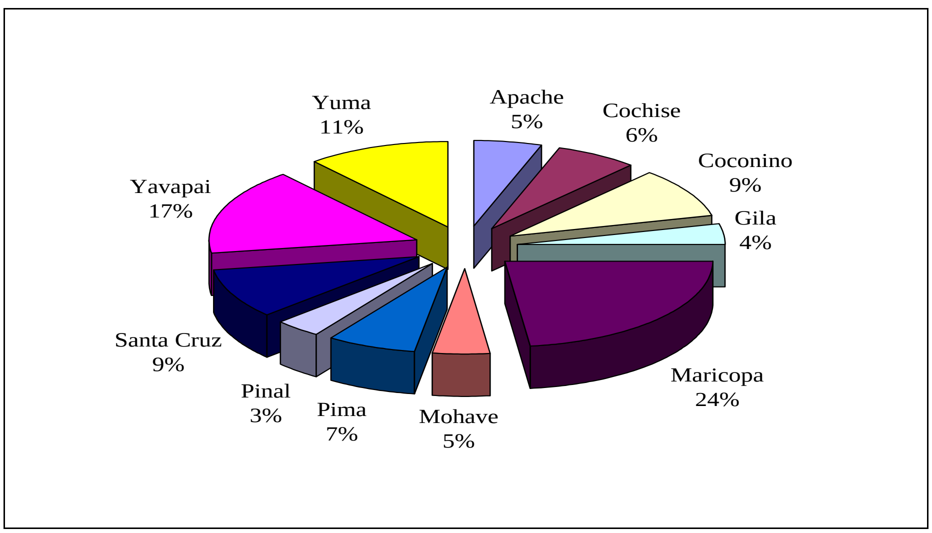

Figure 2. Geographic Distribution of Health Start Program Participants

[4]Arizona's rural counties include: Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Mohave, Navajo, Santa Cruz and Yavapai; urban counties include Maricopa, Pima, Pinal and Yuma (see http://www.azdhs.gov/plan/menu/info/definitions.pdf for more information).

In order to be eligible to participate in the Health Start Program, women must be identified with at least one of the following risk factors: anemia, sickle cell disease, kidney disease, diabetes (gestational or regular), heart problems, high blood pressure, vaginal bleeding, HIV/AIDS or other STD, previous low birth weight, previous preterm birth/labor, previous miscarriage, previous birth complications, current multiple birth, maternal age less than 19 years or greater than 35 years, tobacco use, alcohol use, substance use, domestic violence, no access to regular medical care, chronic debilitating illness, depression, lack of social/family support, less than high-school education, lack of basic needs (food, shelter, etc.), low birth weight, preterm birth, genetic abnormality, substance exposure during pregnancy, and other birth complications, etc. These risk factors are typically self-reported.

The first step in matching the HSP population to a comparable group of women was to select women from the general population who were identified with any of the following risks based on birth certificates and medical records: anemia, diabetes, high blood pressure, uterine bleeding, previous preterm births, genital herpes, and substance use. This provided us with an initial comparison group sample of approximately 17,000 records (note: there are over 100,000 births to Arizona women each year). A simple random sample was then drawn based on the proportional representation of race and ethnicity and geographic residence. The final sample included 5,722 unique cases (HSP = 554; and non-HSP = 5,168) for singleton births only to control for the effects of multiple births on birth outcomes. Out of the total sample of 5,722 cases, approximately 90 percent (5,168) were non-Health Start Participants (henceforth, non-HSP) and 10 percent (554) were HSP participants. Table 1 provides an overview of key demographic variables used in analyzing birth outcomes for Health Start and non-Health Start participants. Missing data was not included and/or imputed for any of the analyses.

Table 1: Distribution of Key Demographic Variables for Health Start and non-Health Start Program Participants (N = 5,722)

Characteristics of key variables	Health Start Participant (N = 554)		Non-Health Start Participant (N = 5,168)	
	Count	Percent	Count	Percent
Race & Ethnicity		***N = 552*** *		***N = 5168***
Hispanics	410	74.28%	3885	75.17%
Whites	74	13.41%	1111	21.50%
Native American	63	11.41%	160	3.10%
Other	5	0.91%	12	0.23%
Geographic location		***N = 554***		***N = 5168***
Rural	307	55.42%	594	11.49%
Urban	247	44.58%	4574	88.51%
Maternal Age		***N = 554***		***N = 5168***
Less than 17 years of age	61	11.01%	175	3.39%
18 to 19 years	86	15.52%	334	6.46%
20 to 29 years	288	51.99%	2739	53.00%
30 to 39 years	112	20.22%	1721	33.30%
40 and above	7	1.26%	199	3.85%
Mother's Education		***N = 546*** *		***N = 5060*** *
Less than 8 yrs of schooling	64	11.55%	391	7.73%
8 yrs of schooling	25	4.51%	168	3.32%
9-11 yrs of schooling	193	34.84%	1322	26.13%
12 yrs of schooling	174	31.41%	1605	31.72%
13-16 yrs of schooling	81	14.62%	1330	26.28%
17+ yrs of schooling	9	1.62%	244	4.82%

*Relates to missing data

The majority of the sample was Hispanic followed by Non-Hispanic Whites. Because of a relatively low number of African American and Asians, they were grouped together in the 'other race' category. While it seemed that there were disproportionate numbers of mothers from urban areas, it should be noted that proportional representation from both the HSP and the non-HSP groups was ensured. Due to unequal sizes and large proportion comprising of the non-HSP group, the rural-urban classification is skewed towards the urban sample. With regards to maternal age and mother's education the sample was normally distributed. Although not shown in the table, approximately 65 percent of both HSP and non-HSP participants received health care through AHCCCS; approximately 30 percent of both program participants and non-participants carried private insurance.

Table 2 provides an overview of the distribution of key outcome variables for the entire sample. 80 percent of the babies born were not low birth weight and/or preterm. This variable was regrouped into a dichotomous measure of ‘low birth weight’ and ‘normal birth weight’ for the purpose of multivariate analyses, which will be described later. While gestation was not utilized as an outcome in itself, this variable was also dichotomized to control for any confounding effects. Approximately four percent of women in the sample indicated that they did not receive any prenatal care and/or had no prenatal care visits. On the contrary, approximately 70 percent of the mothers began their prenatal care in first trimester, and approximately 40 percent of the population had nine to twelve prenatal visits. Another one-fourth of the population had 13 or more prenatal visits.

Table 2: Distribution of Outcome Variables for the Total Sample (n = 5,722)

Characteristics of Outcome Variables	**Count**	**Percent**
Birth Weight (N = 5,719)		
Less 2500 grams	657	11.49%
2500 grams and above	5062	88.51%
Length of Gestation (N = 5,718)		
Less than 37 weeks	1044	18.26%
37 and above	4674	81.74%
Trimester in which prenatal care began (N = 5,712)		
No Prenatal Care	228	3.99%
First Trimester	4109	71.94%
Second Trimester	1112	19.47%
Third Trimester	263	4.60%
Number of Prenatal Visits (N = 5,709)		
No visit	227	3.98%
1-4 visits	327	5.73%
5-8 visits	1123	19.67%
9-12 visits	2513	44.02%
13 plus visits	1519	26.61%

It should also be noted that missing data was less than one percent for all the outcome variables of interest and therefore, none of these variables were imputed for analyses. Because the missing data was negligible in most cases missing data was eliminated from the analyses. The next section describes the measures in greater detail.

Measures

The outcome variables of interest are birth weight, gestational age, and the number of prenatal visits. Birth weight is measured in grams and dichotomized into a categorical variable for the purposes of multivariate analyses. All babies less than 2500 grams are categorized as low birth weight and those equal to or greater than 2500 grams are categorized as ‘normal’ weight. Only 12 percent of the babies were less than 2500 grams. Gestational age is measured in weeks and also dichotomized for the purpose of multivariate analyses. Those with less than 37 weeks are categorized as ‘preterm’ and those greater than or equal to 37 weeks are categorized as ‘full term.’ Twenty (20) percent of babies were born preterm. Prenatal visits is simply measured as the number of times a women receives prenatal care during her pregnancy. Kotelchuck Index Scores (i.e., APNCU Scores) were computed utilizing the number of prenatal visits and initiation of prenatal care. Typically, APNCU scores are categorized as ‘inadequate’ (0 to 49); ‘intermediate’ (50 to 79); ‘adequate’ (80 to 109); and ‘adequate plus’ (110 or more).

Several independent variables (i.e., ‘predictors’ of birth weight) were included such as race and ethnicity, maternal age, maternal education, mother’s residency, substance use during pregnancy (alcohol and/or cigarette use), weight gain during pregnancy, and history of preterm birth(s).

Race/ethnicity was coded into several dummy variables to include: Native American, Hispanic, and ‘Other’ with Non-Hispanic Whites as the reference group. Maternal age in years

(*M = 27.75; SD = 6.57*) was computed based on mother's birth date and birth date of the new born, the youngest mother being 14 years old and the oldest being 58 years old. Mother's education was extracted from birth certificate data; the average education of the mother was nine to eleven years of schooling. Mother's residency was estimated based on the Arizona Vital Statistics classification of metropolitan service areas.

Self-reported alcohol use during pregnancy and cigarette use were also extracted from birth certificate data. Approximately one-fifth of the mothers in the sample indicated that they had smoked during pregnancy and only three percent of the mothers in the sample indicated that they had consumed alcohol.

Weight gain during pregnancy (1= 'no weight gain' … 6 = '31 or more pounds') was reported as an ordinal level variable in the birth certificate data. Approximately 40 percent of the sample gained 31 pounds or more weight during pregnancy; and another 24 percent of the sample gained 25 to 30 pounds; approximately 20 percent of the sample gained 16 to 24 pounds and the remainder 1 to 15 pounds. Only two percent of the sample reported no weight-gain during pregnancy.

Data for mothers with a history of preterm delivery was also extracted from the birth certificates. The proportion of mothers with a history of preterm delivery was very low (2.6%). The next section describes the statistical methods employed to evaluate the key outcome variables of interest. The next section of this report presents the findings of the analysis.

Descriptive Findings

Figure 3 compares birth weights for HSP and non-HSP participants. The birth weight variable was a continuous variable (*M = 3200.56; SD = 678.78*), but was categorized into a dichotomous variable consisting of two values: less than 2500 grams and greater than 2500 grams. It is evident from Figure 3 that the proportion of low birth weight babies for HSP participants was lower when compared to non-HSP participants. The proportion of babies in the low birth weight category was approximately 12 percent for non-HSP compared to four percent for HSP participants. Further, the proportion of babies in the 'normal' birth weight category for HSP participants was 95 percent when compared to 88 percent non-HSP participants. The chi-square statistic was significant at an alpha level of .05, indicating a significant relationship between program status and birth weight. As hypothesized, babies born to mothers in the HSP program had higher birth weights in proportion when compared to babies born to non-HSP mothers.

Independent samples t-tests also confirmed a substantial difference in birth weights between babies born to HSP (*M = 3304.14; SD = 491.54*) and non-HSP mothers (*M = 3189.45; SD = 695.00*), which was statistically significant (t = -4.98, p<.001). This reconfirms our first hypothesis that on an average, HSP participants have higher birth weight babies than non-HSP participants.

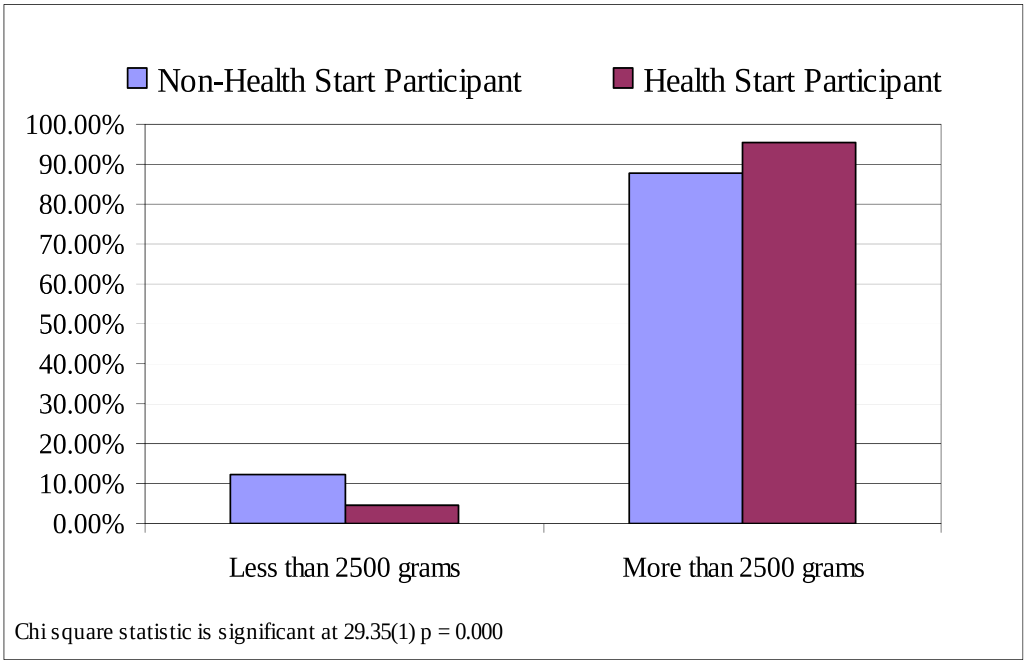

Figure 3. Birth weights of Health Start and Non-Health Start Participants (n = 5,719)

Figure 4 compares the length of gestation for HSP and non-HSP participants. Gestational age is a continuous variable (*M = 37.84; SD = 2.66*), but was again categorized into two distinct values: preterm (< 37 weeks) and full-term (≥ 37 weeks). The minimum gestational age was 16 weeks and the maximum was 44 weeks. It is evident from the figure (see fig. 4) that the proportion of preterm babies (gestational age less than 37 weeks) for non-HSP mothers is higher 19.40%) when compared to HSP mothers (7.61%). Further, the proportion of full-term babies (i.e. gestational age ≥ 37 weeks) was higher for babies of HSP mothers (92.39%) when compared to babies of non-HSP mothers (80.60%).

As hypothesized, the average gestational age of HSP babies (*M = 38.68; SD = 1.83*) was higher than the comparison group of non-HSP women (*M = 37.75; SD = 2.71*). The chi-square statistic of 46.28 indicates a significant relationship between program status and gestational age and the independent samples t-test indicates there was a statistically significant difference in gestational ages for babies born to non-HSP mothers and HSP mothers ($t = -10.78$, $p<.001$).

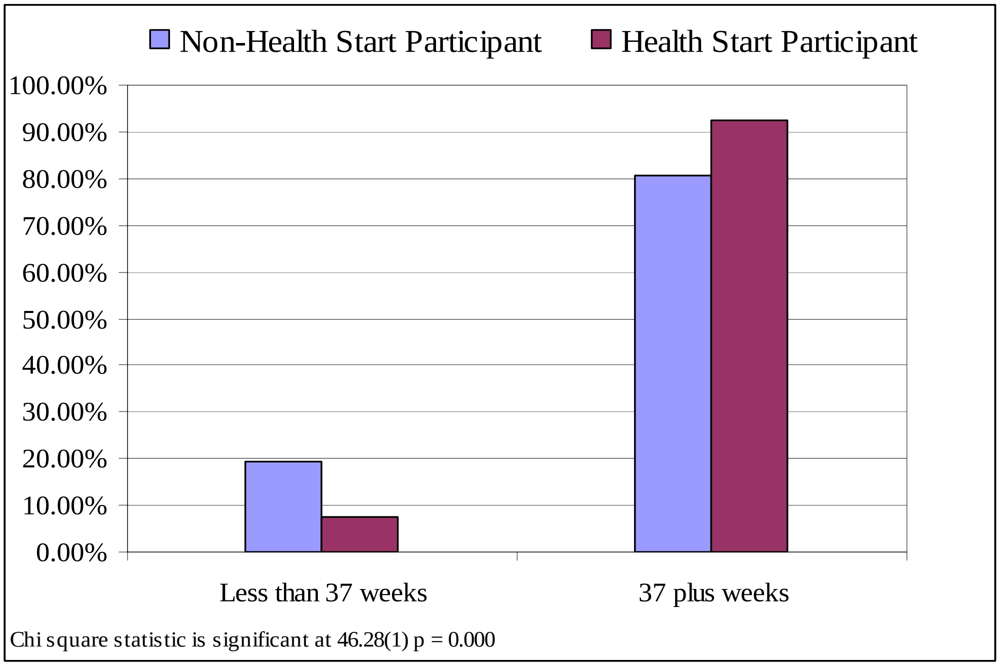

Figure 4. Length of Gestation for Health Start and Non-Health Start Participants (n = 5,718)

Figure 5 compares the number of prenatal visits by HSP and non-HSP participants. The number of prenatal visits was a continuous variable (*M =10.29 ; SD = 4.52*), which was grouped into five distinct categories for the purposes of univariate analyses: no visit, one to four visits, five to eight visits, nine to twelve visits, and thirteen plus visits. The minimum number of visits in the sample was zero and the maximum number of visits was 44. It is evident from the figure (see fig. 5) that the proportion of HSP mothers with 'no prenatal care' visits was lower (2.91%) as opposed to non-HSP mothers (38.36%). In general, HSP participants had a higher proportion of visits when compared to non-HSP participants except for '13 plus visits' category. Testing the hypotheses about the average number of prenatal visits, it was found that HSP participants had lower number of visits when compared to non-HSP participants. Independent t-tests indicated that on an average, non-HSP participants (*M = 10.34; SD = 4.57*) had higher number of prenatal visits when compared to HSP participants (*M = 9.84; SD = 3.99*) and the difference was statistically significant (t = 2.72, p<.01).

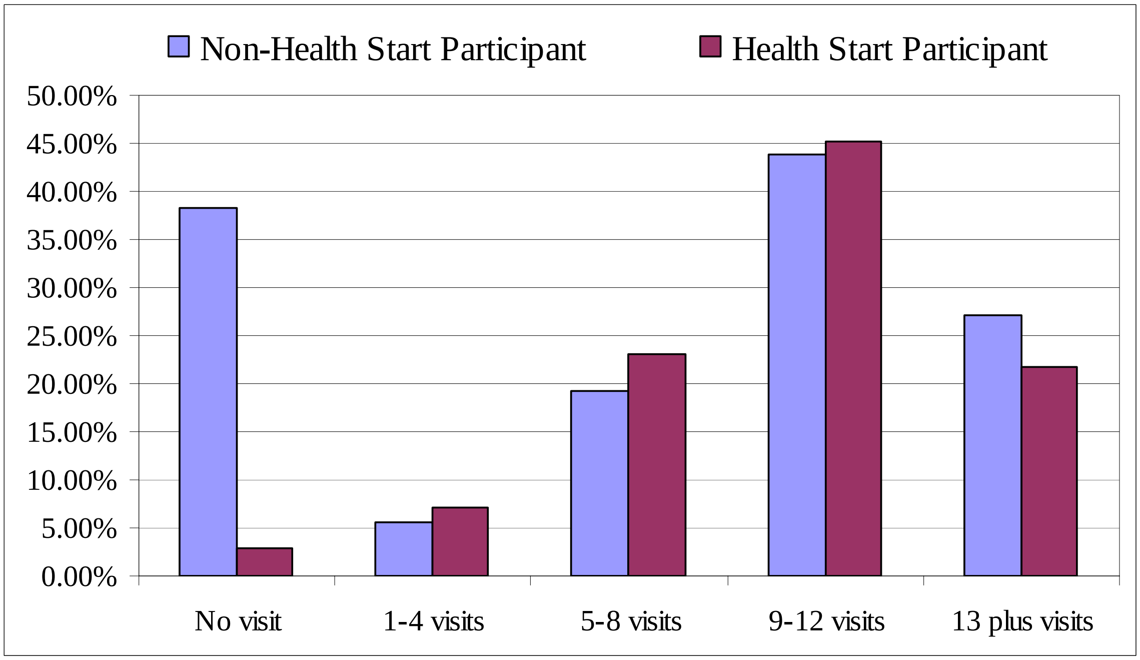

Figure 5. Prenatal Visits by Health Start and Non-Health Start Participants (N = 5,709)

Figure 6 compares the Kotelchuck Index scores (APNCU) for HSP and non-HSP participants. Typically APNCU scores are categorized as 'inadequate' (0 to 49); 'intermediate' (50 to 79); 'adequate' (80 to 109); and 'adequate plus' (110 or more). It is evident from the figure (see fig. 6) that the proportion of individuals who had inadequate prenatal care was unexpectedly higher for HSP (25.77%) participants when compared to non-HSP (19.65%). While the proportion of HSP participants (15.43%) was higher in the intermediate category, the proportion of mothers who received adequate prenatal care was similar for both HSP (36.12%) and non-HSP (36.33%) mothers. Independent samples t-tests confirmed that on average, non-Health Start participants had higher APNCU scores ($M = 2.81; SD = 1.09$) HSP participants ($M = 2.55; SD = 1.10$) and the difference was statistically significant (t = 5.14, $p < .001$).

It should also be noted here that scores on the Kotelchuck Index may not correlate linearly with positive birth outcomes. For instance, expecting mothers may receive a lot of prenatal attention due to some pre-identified medical risk, which would require more prenatal visits and care. This would naturally lead to higher scores on the Kotelchuck Index (i.e., in the range of 'Adequate Plus'), but the expecting mother may still have a poor birth outcome because of the risk. Conversely, women who receive 'Inadequate' prenatal care may still have a good birth outcome. It may be that the women had a healthy, normal pregnancy and did not require extensive prenatal care.

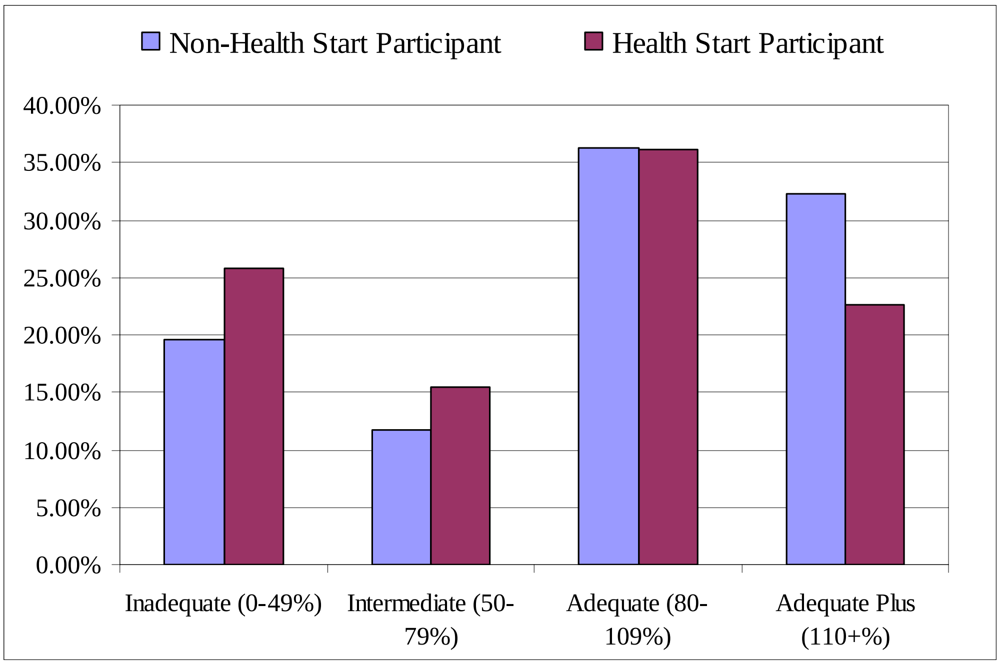

Figure 6. APNCU Scores of Health Start and non-Health Start Participants (N = 5,707)

Figure 7 compares HS and non-HSP participant's entry into prenatal care; that is, the proportion of individuals entering prenatal care in the first, second and third trimester. While there were a fewer HSP participants who did not receive any prenatal care (3.09%) compared to non-HSP participants (4.09%), it is evident that a larger proportion of the non-HSP mothers (72.68%) entered prenatal care than HSP mothers (64.97%). Since data on the month when prenatal care began was available ($M = 2.69; SD = 1.73$), this information was utilized to test if there were any differences in entry into prenatal care. The month of entry into prenatal care ranged from zero months (i.e. no care) to the ninth month. Independent samples t-tests indicated that on an average, HSP mothers (*M = 3.12; SD = 1.76*) entered into prenatal care later than non-HSP mothers (*M = 2.65; SD = 1.72*) (t = -6.03, p<.001).

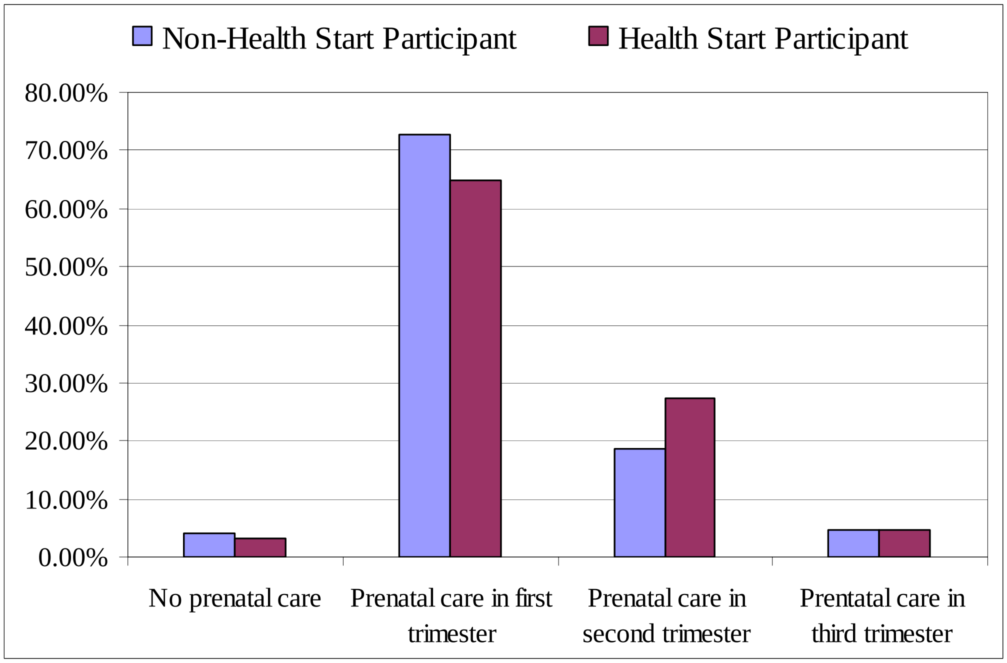

Figure 7. Proportion of Health Start and non-Health Start Mothers' Entry into 1st Trimester of Prenatal Care (N = 5,712)

In summary, initial evidence is supportive of hypotheses H_1 (higher birth weight for babies born to HSP participants) and H_2 (longer gestational periods for HSP participants); however, hypotheses H_3 and H_4, which related to prenatal care, were not supported. In order to provide more concrete evidence that the Heath Start Program really has an effect in reducing the incidence of low birthweight and increasing the gestational period of pregnancies, a multivariate analysis was carried out using logistic regression, which allows us to rule out other causal mechanisms by "controlling for" factors known to influence birth weight and gestation. The results of this analysis are presented below.

Analytic Results

The results of the logistic regression analyses are presented in Table 3, which can be found in the Appendix. A brief summary of the main analytical findings are presented below:

- Women in the Health Start Program were 64% more likely to give birth to a ‘normal’ birth weight baby (i.e., above 2,500 grams) than women not in the Health Start Program, even after controlling for the effects of gestational age and adequacy of prenatal care.

- After controlling for mother’s race/ethnicity, residency, age, education, weight gain during pregnancy, history of preterm birth and substance use during pregnancy, Health Start Program women were 104% more likely to have a positive birth outcome (i.e., normal birth weight baby) than comparison group women.

- Gestational periods greater than or equal to 37 weeks showed significantly better birth outcomes than premature gestation periods for entire sample, controlling for program status and other factors. Pregnancies with normal gestational periods were 35 times more likely, on average, to result in normal birth weights.

- The adequacy of prenatal care (as measured by the Kotelchuck Index) did not show a very strong relationship with birth outcomes. Women who received ‘adequate’ prenatal care were slightly more likely than women who received inadequate prenatal care to have a normal birth weight baby. This effect dissipates, however, with the introduction of controls. An interesting side note here is that the ‘adequate plus’ prenatal care category did not show better birth outcomes in either model. These women receive the most prenatal care visits of all categories, which might indicate that a problem was detected early on in the pregnancy.

- Hispanic women not enrolled in Health Start were 33 percent less likely to have a normal birth weight baby when compared to non-Hispanic Whites not in the program whereas Hispanic women in the Health Start Program were 92 percent more likely to have a normal weight baby when compared to non-Hispanic Whites not in the program.

- Mother’s who lived in urban settings were 54% more likely than rural mothers to have a normal birth weight baby.

- As mother’s age increased, so did their chances of having a positive birth outcome: each additional year of maternal age resulted in a three percent increase in the likelihood of having a child born at 2,500 grams or more.

- An increase from one category to the next in weight gain during pregnancy (e.g., from 1-15 pounds to 16-30 pounds) resulted in a 14% increase in the likelihood of having a normal birth weight baby.

- Surprisingly, none of the substance use factors (alcohol and/or tobacco use during pregnancy) showed a significant relationship with birth outcomes. This may be a result of the drastic underreporting of this information on birth certificate records.

Summary of Key Findings

Analyzing singleton births it was found that Health Start Program participants had favorable outcomes in comparison to non-Health Start Program participants. Babies born to mothers in the Health Start Program were two times as likely to have a normal weight baby than babies born to mothers not in the program – even after controlling for the effects of gestational age, adequacy of prenatal care, weight gain during pregnancy, history of preterm birth, alcohol and cigarette use during pregnancy, and other socio-demographic characteristics of mothers.

As anticipated, longer gestational periods resulted in positive birth outcomes; however, the adequacy of prenatal care did not show strong or consistent effects in predicting positive birth outcomes. Goldfarb, Hillman, Eisenberg, Kelley, Cohen, and Dellheim (1991) also failed to find sufficient evidence regarding the effects of prenatal care on birth weight. Frick and Lantz (1999) note that the "literature has not established clear and consistent evidence that the use of standard prenatal care actually improves birth outcomes" (p. 1064). They note that "despite the policy emphasis, standard prenatal care is not a strong intervention for reducing low birth weight rates or for reducing racial or socioeconomic disparities in poor pregnancy outcomes (p. 1064).

The Health Start Program differentially impacted Hispanics and non-Hispanic Whites. Because the program targets mostly Hispanic in Arizona, the program seems to be most effective in this population. It has been observed that "Latinos of Mexican descent have one of the lowest risks of LBW births of any racial or ethnic group" (Scribner & Dwyer, 1989, p. 1263) and especially foreign-born Latinos who are known to have better outcomes (Avecedo-Garcia, D., Soobader & Berkman, 2007). Mexican-origin mothers tend to have favorable birth outcomes despite generally low socioeconomic status—a finding that has been referred to as an ‘epidemiological paradox,’ and favorable for this group could be attributed to cultural factors, healthy behaviors, lower rate of substance use, and immigrant selectivity (Reichman, Hamilton, Hummer, & Padilla, 2008). However, this study also found evidence that Hispanics who are not in the program when compared to non-Hispanic Whites who are not in the program do not have better outcomes. Possible factors could be adaptation to the cultural norms of the host society (U.S.), lack or loss of social networks or social supports, lack of education, poor socio-economic status etc., which may need to be specifically tested within this sub-sample.

Study Limitations

An important caveat for this study is that several factors influence birth weight outcomes and only a few of those were controlled for in this study. A major feature of the Health Start Program is to provide prenatal care services to women, which can be regarded as a direct outcome of the program. Although it was found that there were no significant differences in the adequacy of prenatal care received, average scores on prenatal visits were higher in non-HSP population when compared to HSP population of high risk mothers. Further, Health Start mothers initiated prenatal care much later in the trimester than non-Health Start mothers indicating that there is tremendous scope for improving prenatal care services in the Health Start Program. Another important caveat is the fact that while the risk factors were controlled for by the research design of this study, it is possible that there could be reporting bias on the part of HSP participants about their risks. Ideally, one could evaluate the risk factors through Primary Care Physician referrals among HSP participants to ensure better services; however, it may not be necessarily feasible as it may distract the focus and the goals of the program and may require additional resources. While there is compelling evidence of success of Health Start Program for Hispanics, these outcomes need to be further tested over time to determine program efficacy.

Methodologically, the evaluation study can be considered a quasi-experimental study as the comparison group was matched on several risk factors assessed during Health Start Program enrollment. Because serving all the high risk participants at any given time is seldom possible, a 'natural' comparison group exists to which program participants' birth outcomes could be compared. A more rigorous evaluation study could encompass a smaller comparable pilot site with no Health Start intervention of high risk pregnant mothers. The risk factors data can be collected for both these groups utilizing medical records prior to any intervention and then the birth outcomes could be analyzed over time. However, such a study in a population-based program is often impractical due to ethical issues.

Another limitation is that while low birth weight is an important predictor it is also controversial because emerging debates on its measurement and classification, standardization of the variable, and its relationship to infant mortality. While infant mortality can be evaluated as an outcome for success the relatively small cases available at any given time for program data makes it impossible to generalize.

Lastly, the study was limited in that it could not report information on childhood immunizations, which is related to one of the primary goals of the Health Start program. This data was not currently available for the non-Health Start clients and therefore could not be used in this study.

Recommendations

The processes and outcomes of this study revealed a few areas for improvement for the Health Start Program, which may or may not be feasible to address. Therefore, the following recommendations are made in an effort to improve the efficacy and overall capacity of the Health Start Program:

- First and foremost, collecting birth certificate numbers for all the Health Start enrolled clients in the database can greatly transform the matching of vital statistics records such birth records, death records, and medical records which can facilitate linking with other databases and more accurate and reliable data. It can not only help more efficient matching process, but this information can help in triangulation of the data and also can be potentially useful in conducting longitudinal studies.
- Second, and just as important as the first recommendation, is to strengthen the prenatal visits among program participants. The study revealed disparities in average number of visits, initiation of prenatal care and Kotelchuck Index between Health Start and non-Health Start participants.
- Third, there is a disproportionate number of Hispanics in the population that may potentially confound evaluation results because of their relatively low disposition of risks when compared to other race and ethnicities. Diversifying the Health Start clientele could help in not only assessing race and ethnic differences but can also help build ‘tailored’ interventions to different sub-populations.

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APPENDIX

Table 3: Logistic Regression Analysis of Birth Weight Outcomes

Variables	**Model I**	**Model II**
Health Start Participant	1.64**	2.04**
(Reference: Non-Health Start)	(1.03 - 2.63)	(1.22 - 3.40)
Gestational age	35.18***	34.98***
(Reference: < 37 weeks)	(28.04 - 44.15)	(27.65 - 44.25)
Intermediate prenatal care	1.36	1.36
(Reference: Inadequate care)	(0.85 - 2.15)	(0.84 - 2.20)
Adequate prenatal care	1.45*	1.40
(Reference: Inadequate care)	(0.98 - 2.13)	(0.93 - 2.13)
Adequate plus prenatal care	1.18	1.13
(Reference: Inadequate care)	(0.83 - 1.68)	(0.77 - 1.66)
Hispanics		0.75**
(Reference: Whites)		(0.56 - 1.00)
Other race and ethnicity†		1.47
(Reference: Whites)		(0.23 - 2.89)
Mother's residency		1.54***
(Reference: Rural)		(1.1 - 2.15)
Mother's age in years		1.03***
		(1.01 - 1.04)
Mother's education in years		0.93
		(0.85 - 1.01)
Weight gain during pregnancy		1.14***
		(1.07 - 1.22)
Maternal history of preterm birth		0.73
(Reference: No history)		(0.43 - 1.24)
Alcohol use during pregnancy		1.04
(Reference: No use)		(0.50 - 2.15)
Cigarette use during pregnancy		1.10
(Reference: No use)		(0.80 - 1.50)
-2 LL	***2570.411***	***2463.427***

***p < 0.01 **p < 0.05 *p <0.10

†Includes Native Americans, Blacks, and Asians

Model I presents odds ratios and standard errors (in parentheses) for the key independent variables (HS program status, gestational period, and adequacy of prenatal care as measured by the Kotelchuck Index). Model II presents the same information, but adds a set of control variables (race/ethnicity, mother's residency, age, education, weight gain during pregnancy, history of preterm birth, and use of substances during pregnancy. Odd ratios greater than one indicate a positive relationship with the outcome variable; less than one indicates a negative relationship, and odd ratios equal to one indicates no relationship.

In Model I, the effects of the Health Start Program on positive birth outcomes is evident: women in the Health Start Program are 64% more likely to give birth to a 'normal' birth weight baby (i.e., above 2,500 grams) than women who are not in the Health Start Program, even after controlling for the effects of gestational age and adequacy of prenatal care. In Model II, where additional control measures are added to the equation, the HS program effects are amplified. After controlling for mother's race/ethnicity, residency, age, education, weight gain during pregnancy, history of preterm birth and substance use during pregnancy, *Health Start Program women are 104% more likely to have a positive birth outcome (i.e., normal birth weight baby) than comparison group women.* So in short, the Health Start Program shows significant gains in promoting positive birth outcomes for its participants.

Separate regression models were not estimated for gestational period and the adequacy of prenatal care since these are both viewed as 'predictors' of the ultimate outcome of birth weight. However, it can be said that gestational periods $\geq$ 37 weeks showed significantly better birth outcomes than premature gestation periods for entire sample, controlling for program status and other factors (see Table 3). According to the Models, *pregnancies with normal gestational periods were 35 times more likely, on average, to result in normal birth weights.* However, the adequacy of prenatal care as measured by the Kotelchuck Index did not show such powerful and consistent results. In Model I, we find that women who received 'adequate' prenatal care were slightly more likely than women who received inadequate prenatal care to have a normal birth weight baby. This effect dissipates, however, with the introduction of controls in Model II. An interesting side note here is that the 'adequate plus' prenatal care category did not show better birth outcomes in either model. These women receive the most prenatal care visits of all categories, which might indicate that a problem was detected early on in the pregnancy.

In terms of the control variables, we found several significant effects on birth outcomes. First, we find that Hispanic mothers show poorer birth outcomes than their White counterparts once we control for program status, gestational age, adequacy of prenatal care and other factors. In an analysis not presented, mother's race/ethnicity was interacted with HS program status so that separate estimates were established for Hispanic women in the program vs. not in the program, etc. (the reference group was non-Hispanic Whites, not in the program). Hispanics not in the program were 33 percent less likely to have a normal weight baby when compared to non-Hispanic Whites not in the program whereas *Hispanic women in the Health Start Program were 92 percent more likely to have a normal weight baby when compared to non-Hispanic Whites not in the program*. It appears then that Hispanic women in the program have a particular advantage of having better birth outcomes.

Mother's who lived in urban settings were 54% more likely than rural mothers to have a normal birth weight baby. As mother's age increased, so did their chances of having a positive birth outcome: each additional year of maternal age resulted in a three percent increase in the likelihood of having a child born at 2,500 grams or more. While not tested in the current analysis, it is possible that a curvilinear effect occurs with mother's age so that younger (e.g., teenage) mothers and older (e.g., 35+) mothers have negative birth outcomes while women of normal childbearing age (e.g., 20-34) have positive birth outcomes. Lastly, an increase from one category to the next in weight gain during pregnancy (e.g., from 1-15 pounds to 16-30 pounds) resulted in a 14% increase in the odds of having a normal birth weight baby.

Surprisingly, none of the substance use factors (alcohol and/or tobacco use during pregnancy) showed a significant relationship with birth outcomes. This may be a result of the drastic underreporting of this information on birth certificate records.